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A novel neuro-probabilistic framework for energy demand forecasting in Electric Vehicle integration

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Abstract-

This paper presents a novel grid-to-vehicle modeling framework that leverages probabilistic methods and neural networks to accurately forecast electric vehicle (EV) charging demand and overall energy consumption. The proposed methodology, tailored to the specific context of Medellin, Colombia, provides valuable insights for optimizing charging infrastructure and grid operations. Based on collected local data, mathematical models are developed and coded to accurately reflect the characteristics of EV charging. Through a rigorous analysis of criteria, indices, and mathematical relationships, the most suitable model for the city is selected. By combining probabilistic modeling with neural networks, this study offers a comprehensive approach to predicting future energy demand as EV penetration increases. The EV charging model effectively captures the charging behavior of various EV types, while the neural network accurately forecasts energy demand. The findings can inform decision-making regarding charging infrastructure planning, investment strategies, and policy development to support the sustainable integration of electric vehicles into the power grid.

Index Terms- electric vehicle charging; forecasting; neural networks; probabilistic approach

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